PATENT SPECIFICATION

646,642

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PROVISIONAL SPECIFICATION

Improvements in Colour Lighting Apparatus

I, ROLLO GILLESPIE WILLIAMS, a British Subject, of 23, Bellingham Lane, Great Neck, Long Island, New York, United States of America, do hereby declare the nature of this invention to be as follows:—

This invention concerns colour lighting apparatus, and especially spotlight equipment, which will enable a number of light sources each giving a light of different colour to provide illumination which can be blended into one final beam of light.

It is sometimes desired to mingle the light of four basic colours, white, red, green and blue, in such a manner that by blending the lights in different proportions different colour hues are obtained. If four spotlights corresponding to these four colours are mounted close together, it will be found that the four beams do not generally intermingle sufficiently to avoid what is known as colour fringing, and frequently undesirable colour shadows are created.

It is therefore desired that these beams should be so intermingled that the fundamental colours in question can be sufficiently combined to avoid this phenomenon, and an object of the present invention is apparatus whereby this result may be achieved. It is to be understood however that this invention applies to the combination of any required number of (fundamental) coloured light sources, and that the number "four" is quoted as an example. Also the sources can be arranged to give any desired colour of light and means such as for example those disclosed in the specification of concurrent Patent Application No. 5350/45 may be employed for varying the colour and/or intensity of the useful emitted light.

The expression "useful emitted light" used herein means the amount of light which is eventually used for illuminating or other purposes and if means, such as for example Iris diaphragms are employed for controlling the light from any light source, it will be appreciated that the amount of useful emitted light may be less than the amount of light emitted, that is produced by the source. According to the present invention means are provided whereby a major light beam is split open into a number of component beams predetermined of said component beams are transposed and means are provided for combining the component beams into a unitary beam. The expression "major beam" is used as a matter of convenience to indicate a beam from any convenient source of light and includes where the context so permits, a plurality of beams derived from a single beam. According to one method of carrying the invention into effect colour lighting apparatus is provided comprising a light source or plurality of light sources or other means affording a plurality of major beams of light in combination with two optical systems, the first of which functions to split each major beam into a plurality of component beams and transposes said component beams or predetermined thereof and the second of which collects said component beams and transmits them as a unitary beam.

Specifically the first optical system is so constructed and arranged that the number of component beams into which each major beam is split, is preferably a multiple of the number of sources.

The foregoing and other features of the invention are incorporated in the apparatus hereinafter described with reference to the accompanying diagrammatic drawings in which Fig. 1 is a sectional plan of the apparatus (taken on the line A—A in Fig. 2).

Fig. 2 is an elevation of the first optical system.

Fig. 3 is a diagram illustrating the

manner in which the first system splits and transposes the beams emanating from the various sources.

It is to be assumed that it is desired to combine the lights of four different colours emanating from four separate light sources, which in the drawings are given the respective references. R (for Red), G (for Green). B (for Blue) and W (for White).

The four light sources may be mounted say in pairs one above the other so that the two pairs form say a square or rectangle each light source being more or less separated from the others. The desired hue of coloured light can be provided by means of a colour filter associated with each or selected of the light sources or each light source itself can emit coloured (including white) light.

On front of these light sources, there is a first optical system 1, one function of which is to collect the major beam from each source and transmit a plurality of separate narrow-angle (or parallel) component beams. On the drawings these component beams are given the reference letter of the source from which they emanate, primed with an index number 1, 2, 3 or 4 as the case may be. There will preferably be as many component beams of light (or multiples of this number) from each light source as there are fundamental colours to be mingled. Thus, if four colours are to be mingled in one final beam, the light collected from each source is divided into four (or multiples of four) separate beams of light. This can be done either by one composite lens or by a number of separate lenses suitably mounted for each light source.

Thus in the drawings the component beams are indicated at R^1, R^2, R^3, R^4, G^1, G^2, etc., the component lenses that constitute the first optical system 1, are indicated at r^1, r^2, r^3, r^4, g^1, g^2, etc.

A further function of the first optical system 1 is to transpose certain or all of the component beams from the various sources so that their location, in a plane substantially normal to the general direction of light transmission is changed and a "jumbling" or "scrambling" of the component beams results. On Fig. 2 arrows indicate the direction in which certain component beams are diverted for this purpose, while Fig. 3 illustrates the resultant transposition and may be considered as representing a section taken in the said plane.

All these component light beams are transmitted to a second optical system (or straightener) 2 mounted at a convenient distance in front of the first system. The second system can either take the form of one composite lens or a number of separate lenses suitably mounted and can be either larger or smaller in area than the first set of lenses or composite lens.

Some or all of the component beams of light from the first system or set of lenses nearest to the light sources will enter the second system or set of lenses at an angle, but the second set of lenses will be arranged to bring all the component beams into a parallel or nearly parallel direction with each other, as illustrated in Fig. 1. To accomplish this, it is necessary for each separate lens (or section of a composite lens) in the first system 1 to have a complementary lens (or part of a composite lens) in the second system 2. The second set of lens (or part of a composite lens) will, however, be arranged in a different order.

Some of the component light beams from the first system may enter the second system directly, i.e., not at an angle, but other component beams will be deflected by the first system, so as to enter the second system at an angle, so that there will be a greater distance between, say, two component light beams of the same colour after passing through the second system than was the case when the light beams left the first system. The second system will, however finally bring all the component light beams into one final narrow angle, or parallel beam of light of the kind provided by spotlights. In this manner lights of different colours are more closely mingled in one final beam.

The expression "optical system" and "lenses" or "set of lenses" as used in this description is meant to cover the necessary prisms or lenses required to produce the desired collection and/or deflection of light rays and, in practice each lens may in fact be a composite lens, or a combination of lenses as required to carry out the desired control of the light rays.

The second set of lenses can if desired be arranged also to diffuse or widen the angle of the final composite beam of light.

It will be appreciated that instead of there being a plurality of separate and distinct light sources which, as hereinbefore described, generate separate major beams, there may be a common source, the light from which is divided into the plurality of major beams each of which is subsequently split into a number of component beams. There may for example be positioned on front of a single light source a multi-coloured filter. The filter may for example be in the form of a square divided into four equal squares

and one of these squares is coloured red, the other green, the third blue and the fourth white. In this manner from a single source of light four major beams of four different colours are obtained and these four major beams are transmitted to the first optical system and from thence to the second optical system in the manner previously described. It will be appreciated that there may be any desired number of individual light sources giving a plurality of major beams, in manner described and predetermined of said major beams are transmitted to the second optical system in accordance with the present invention.

Since these major beams all emanate from a common source, their individual intensities cannot easily be varied by means of dimmers or the like. On the other hand, the amount of light finally utilised from each beam (and transmitted through the optical systems) may be varied by control means such as an iris diaphragm, movable shutter or shutters, or one or more movable lenses, through which the beam passes on its way to the first optical system. Such means may be operated individually and/or collectively. For example there may be patterning mechanism which may be pre-set to afford a predetermined combination of settings of said controlling means and mechanism whereby the controlling means are adjusted in accordance with any selected combination. Control mechanism that may be adapted for this purpose forms the subject matter of co-pending Patent Application No. 5350/45.

From the foregoing it will be seen that by the present invention a spotlight of any desired colour hue can be obtained by employing either a plurality of light sources each emitting a major beam or by employing a single light source from which a plurality of major beams are obtained such as by the use of a multi-coloured filter. The control apparatus which as stated may conveniently be of the type described in the Specification of co-pending Patent Application No. 5350/45 may be utilised to give any predetermined colour or any predetermined sequence of different colours.

Dated this 12th day of December, 1946.

ERIC POTTER & CLARKSON,
Chartered Patent Agents,
Nottingham, London and Leicester.

COMPLETE SPECIFICATION

Improvements in Colour Lighting Apparatus

I, ROLLO GILLESPIE WILLIAMS, a British Subject, of 23, Bellingham Lane, Great Neck, Long Island, New York, United States of America, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention concerns colour lighting apparatus and especially spotlight equipment, which will enable a number of light sources each giving a light of different colour to provide illumination which can be blended into one final beam of light.

It is sometimes desired to mingle the light of a plurality of colours such for example as the four colours, white, red, green and blue, in such a manner that by blending the lights in different proportions different colour hues are obtained. If four spotlights corresponding to these four colours are mounted close together, it will be found that undesirable colour shadows are created and the four beams do not generally intermingle sufficiently to avoid what is known as colour fringing.

It is therefore desired that these beams should be so intermingled that the colours in question can be sufficiently combined to avoid these phenomena, and an object of the present invention is to provide apparatus whereby this result may be achieved. It is to be understood however that this invention applies to the combination of any required number of coloured light sources, and that the number "four" is quoted as an example. Also the source can be arranged to give any desired colour of light and means may be employed for varying the colour and/or intensity of the useful emitted light. For example, in the case of a plurality of light sources, individual dimmers may be employed to vary the useful emitted light.

The expression "useful emitted light" used herein means the amount of light which is eventually used for illuminating or other purposes and if means, such as for example iris diaphragms are employed for controlling the light from any light source, it will be appreciated that the amount of useful emitted light may be less than the amount of light emitted, (that is, produced) by the source. According to the present inven-

tion means are provided whereby each of several major light beams of different colours is split into a number of component beams; predetermined of said component beams are transposed so as to mingle the colours and means are provided for combining the component beams in their transported relationship into a unitary beam. The expression "major beam" is used as a matter of convenience to indicate a beam from any convenient source of light and includes, where the context so permits, a plurality of beams derived from a single beam; specifically, it is employed (where the context so admits) to mean the flux of light allocated to any one colour before the splitting takes place. According to one method of carrying the invention into effect colour lighting apparatus is provided comprising a light source of plurality of light sources or other means affording a plurality of major beams of light of different colour, in combination with two optical systems, the first of which functions to split each major beam into a plurality of component beams and transposes some component beams or predetermined thereof and the second of which collects said component beams in their transposed relationship and transmits them as a unitary beam. The expression "optical system" as used herein means an arrangement of lenses, prisms, or reflectors, or any combination thereof.

Specifically the first optical system is so constructed and arranged that the number of component beams into which each major beam is split, is preferably a multiple of the number of colours to be mingled.

The above and other features of the invention are set forth in the appended claims and are disclosed in the detailed description, given by way of example, of the particular embodiments illustrated in the accompanying drawings in which:—

Figure 1 is a sectional plan of the apparatus (taken on the line A—A in Figure 2).

Figure 2 is an elevation of the first optical system.

Figure 3 is a diagram illustrating the manner in which the first system splits and transposes the beams emanating from the various sources as viewed on the plane of the second optical system.

Figure 4 is a diagram illustrating how reflectors may be used in the optical systems.

Figure 5 is a diagram illustrating the use of lenses and reflectors in the first optical system.

Figure 6 is a diagram illustrating a first optical system consisting of reflectors and a second optical system consisting of refracting prisms and masks.

Figure 7 is a diagram illustrating an arrangement in which the emission of a single source is divided into a plurality of major beams.

It is to be assumed that it is desired to combine the light of four different colours emanating from four separate light sources, which may be referred to as R (for red), G (for green), B (for blue) and W (for white).

The four light sources may be mounted say in pairs one above the other so that the two pairs form say a square or rectangle each light source being more or less separated from the others. The desired hue of coloured light can be provided by means of a colour filter associated with each or selected of the light sources at any location between the source and the emergence of the final unified beam (e.g. the lenses of one or each optical system may be made of coloured glass) or each light source itself can emit coloured (including white) light.

From each source, there emanates a major beam; in Figure 1 the major beams from sources R and G are indicated at 1R and 1G respectively. In front of the light sources, there is a first optical system 1, one function of which is to collect the major beam from each source and transmit a plurality of separate narrow-angle (or "parallel") component beams. On the drawings these component beams are given the reference letter of the source from which they emanate, primed with an index number 1, 2, 3 or 4 as the case may be. There will preferably be as many component beams of light (or multiples of this number) from each light source as there are fundamental colours to be mingled. Thus, if four colours are to be mingled in one final beam, the light collected from each source is divided into four (or multiples of four) separate beams of light. This can be done either by one composite lens or by a number of separate lenses suitably mounted for each light source.

Thus in the drawings the component beams are indicated at R^1, R^2, R^3, R^4, G^1, G^2, etc. the component lenses that constitute the first optical system 1, are indicated at r^1, r^2, r^3, r^4, g^1, g^2 etc.

A further function of the first optical system 1 is to transpose certain or all of the component beams from the various sources so that their location, in a plane substantially normal to the general direction of light transmission is changed and a "jumbling" or "scrambling" of the component beams results. On Figure 2 arrows indicate the direction in which

certain component beams are diverted for this purpose, while Figure 3 illustrates the resultant transposition at the second system and may be considered as representing a section taken in the said plane, showing the resultant "patchwork" effect.

All these component light beams are transmitted to a second optical system (or straightener) 2 mounted at a convenient distance in front of the first system. The second system (of Figure 1) can either take the form of one composite lens or may include a number of separate lenses suitably mounted and can be either larger or smaller in area than the first set of lenses or composite lens.

Some or all of the component beams of light from the first system 1 or set of lenses nearest to the light sources will enter the second system 2 or set of lenses at an angle, but the second set of lenses will be arranged to bring all the component beams into a parallel or nearly parallel direction with each other, as illustrated in Figure 1. To accomplish this, it is necessary for each separate lens (or section of a composite lens) in the first system 1, which transposes a beam, to have a corresonding lens (or part of a composite lens) in the second system 2. The second set of lenses (or part of a composite lens) will, however, be arranged in a different order.

Some of the component light beams from the first system may enter the second system in a non-transposed direction, i.e. not at an angle, but other component beams will be deflected by the first system, so as to enter the second system at an angle, so that there will be a greater distance between, say, two component light beams of the same colour after passing through the second system than was the case when the light beams left the first system. The second system will, however finally bring all the component light beams into one final narrow angle, or parallel beam of light of the kind provided by spotlights. In this manner lights of different colours are more closely mingled in one final beam.

In Figure 4, the light from the sources of which R and G are examples, is collected and projected forwards as parallel major beams IR and IG by parabolic reflectors 3 and 4 which beams pass through nests of black masking rings or slots 5 and 6. These permit the passage of the light from the reflectors 3 and 4 without obstruction but substantially prevent the passage of light direct from the sources. Each major beam is broken up into its component beams by the first optical system and certain component beams from the two major beams are transposed. This is effected by allowing component beams R^1, G^2 to pass straight ahead without interference but by deflecting component beams R^2, G^1 by strip reflectors 7, 8. At the second optical system 2, beams R^1, G^2 again pass straight ahead, but component beams R^2, G^1 are straightened by strip reflectors 9 and 10.

In Figure 5, reflectors 3^1, 4^1 are employed to collect the light from each source into its major beam. The first optical system 1 comprises lens plates 11 and 12 with circular prisms formed thereon serving to straighten the major beams and reflectors 7 and 8 for splitting and transporting. In Figure 6 the major beam directed rearwardly from each source R and G is split into its component beams, and the required transposition is effected, by suitably shaped reflectors or reflector sections 13, 14, 15, 16 (one for each component beam of each initial colour). The transposed beams R^2 and G^1 are directed by their reflectors 14, 15 to the means (here shown as refracting prisms 17, 18) in the second system 2 by which they are straightened; in passage to the second system they are masked by plates 19, 20 which prevent the emergence of stray light. The component beams R^1 G^2 that are thrown by reflectors 13, 16 straight forward to the second system also pass through masking plates 19, 20 which have a similar purpose to the plates masking R^2 and G^1 and which also suppress light travelling directly forwards from the sources R, G.

In Figures 4 and 6 instead of reflectors behind the sources, the light from the sources may be collected into parallel major beams by reflector means located in front of the sources.

It will be appreciated that instead of there being a plurality of separate and distinct light sources which, as hereinbefore described, generate separate major beams, there may be a common source such as X in Figure 7, the light from which is divided into the plurality of major beams by means such as reflectors 21, 22 one for each beam each of which beam is subsequently split into a number of component beams. There may for example be positioned in front of or behind a single light source a multi coloured filter indicated at 23. The filter may for example be in the form of a square divided into four equal squares and one of these squares is coloured red, the other green, the third blue and the fourth clear. In this manner from a single source of light four major beams of four different colours are obtained and these

four major beams are transmitted to the first optical system 1 and from thence to the second optical system 2 in the manner previously described. It will be appreciated that there may be any desired number of individual light sources giving a plurality of major beams in the manner described and predetermined of said major beams are transmitted to the second optical system in accordance with the present invention.

Since these major beams all emanate from a common source X, their individual intensities cannot easily be varied by means of dimmers or the like. On the other hand, the amount of light finally utilised from each beam (and transmitted through the optical systems) may be varied by control means 24, 25 such as an iris diaphragm, movable shutter or shutters, or one or more movable lenses, through which the beams pass on their way to the first optical system 1. Such means may be operated individually and/or collectively. For example there may be patterning mechanism which may be pre-set to afford a predetermined combination of settings of said controlling means and mechanism whereby the controlling means are adjusted in accordance with any selected combination. The first optical system illustrated comprises main lenses 11 and 12 and transposing lenses r^2 g^1, while the second system 2 comprises straightening lenses $2r^2$ and $2g^1$.

The expression "optical system" and "lenses" or "set of lenses" as used in this description is meant to cover the necessary prisms, lenses, or reflectors required to produce the desired collection and/or deflection of light rays and, in practice each lens may in fact be a composite lens, or a combination of lenses as required to carry out the desired control of the light rays.

The optical system of any of the forms illustrated and described can, if desired be arranged also to diffuse or widen the angle of the final composite beam of light.

From the foregoing it will be seen that by the present invention a resultant light beam of any desired colour hue can be obtained by employing either a plurality of light sources of different colours each emitting a major beam, the relative intensity of which may be varied as required or by employing a single light source from which a plurality of major beams of different colours are obtained such as by the use of a multi coloured filter, it being understood that the relative intensity of said beams may be varied as required as by the use of shutters or diaphragms. The control apparatus which may conveniently be of any known or approved type may be utilised to give any predetermined colour or any predetermined sequence of different colours.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. In colour lighting apparatus the combination of means so arranged as to split each of several major beams (as herein defined) of different colours into a plurality of component beams, means so arranged as to transpose at least some of the component beams so as to mingle the colours and means so arranged as to combine the component beams into a unitary beam in their transposed relationship.

2. In colour lighting apparatus according to Claim 1 a first optical system so arranged as both to split each major beam into a plurality of component beams and also to transpose at least some of them, and a second optical system so arranged as to collect the component beams in their transposed relationship and transmit them as a unitary beam.

3. In colour lighting apparatus according to Claim 1 a single source of light, in combination with means for deflecting the light emission from said source into a plurality of major beams of different colours, each of which major beam is split into a plurality of component beams for the subsequent transposition and recombination.

4. Colour lighting apparatus according to Claim 1 2 or 3 in which the number of components into which each major beam is split is the same as or is a multiple of the number of colours to be mingled.

5. Colour lighting apparatus according to any of the preceding claims having four major beams split and transposed as amplified in Figures 2 and 3 of the accompanying drawing.

6. Colour-lighting apparatus according to Claim 1 constructed and adapted to function substantially according to any of the alternatives herein described with reference to and illustrated in the accompanying drawing.

Dated this 11th day of December, 1947.
ERIC POTTER & CLARKSON,
Chartered Patent Agents.
Nottingham, Leicester and London.

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FIG. 1.

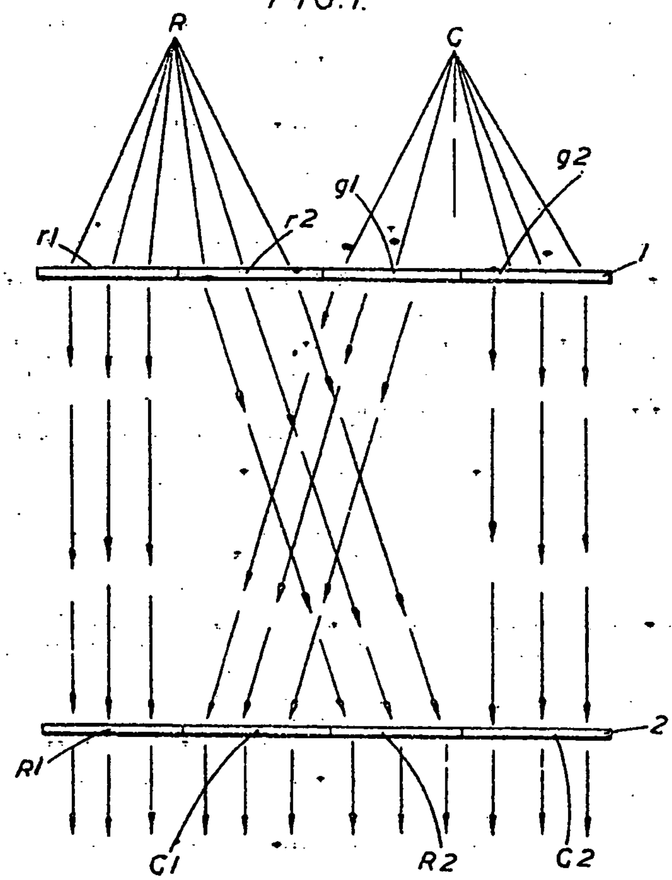


FIG.2.

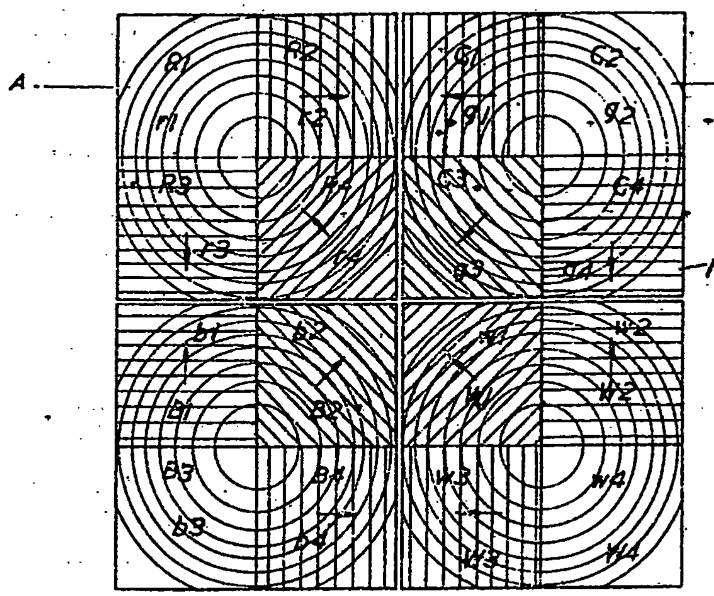
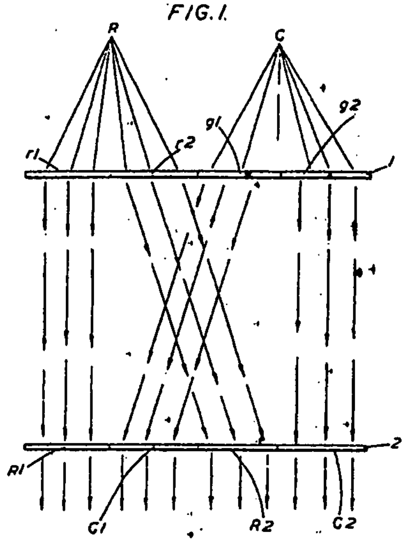


FIG.3.

R1	C1	R2	C2
B1	W1	B2	W2
R3	C3	R4	C4
B3	W3	B4	W4

SHEET 1

FIG. 1.



SHEET 2

FIG. 2.

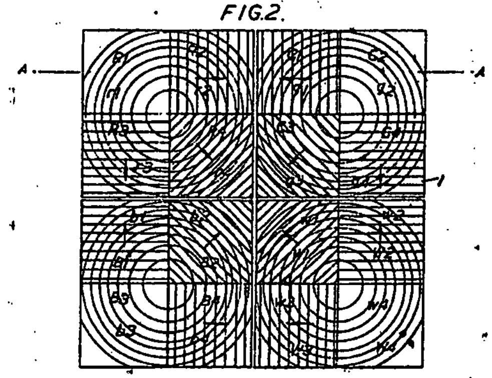
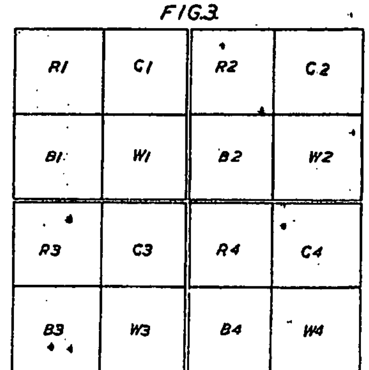


FIG. 3.



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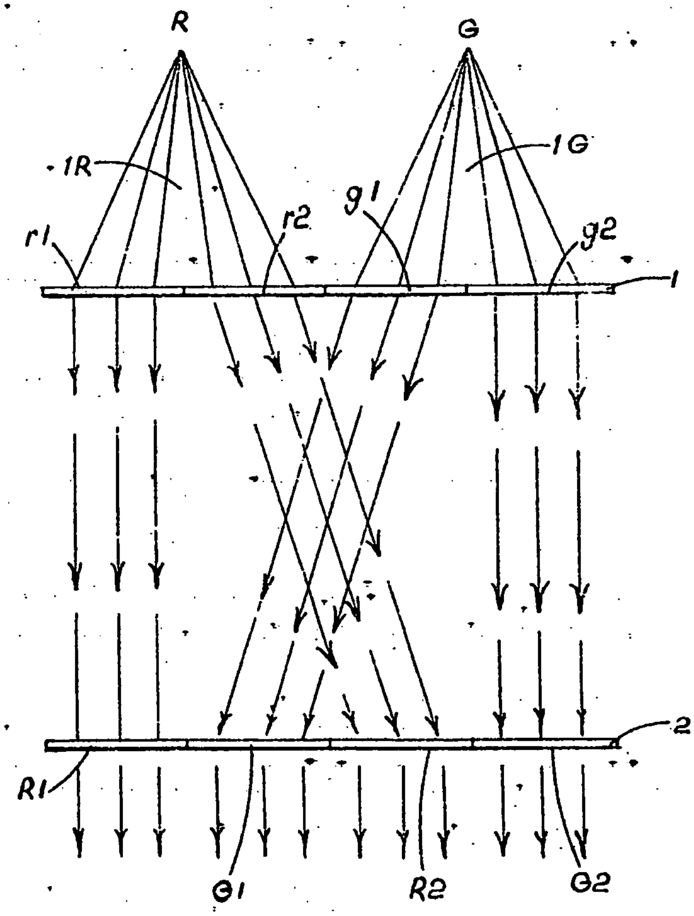

FIG. 1.

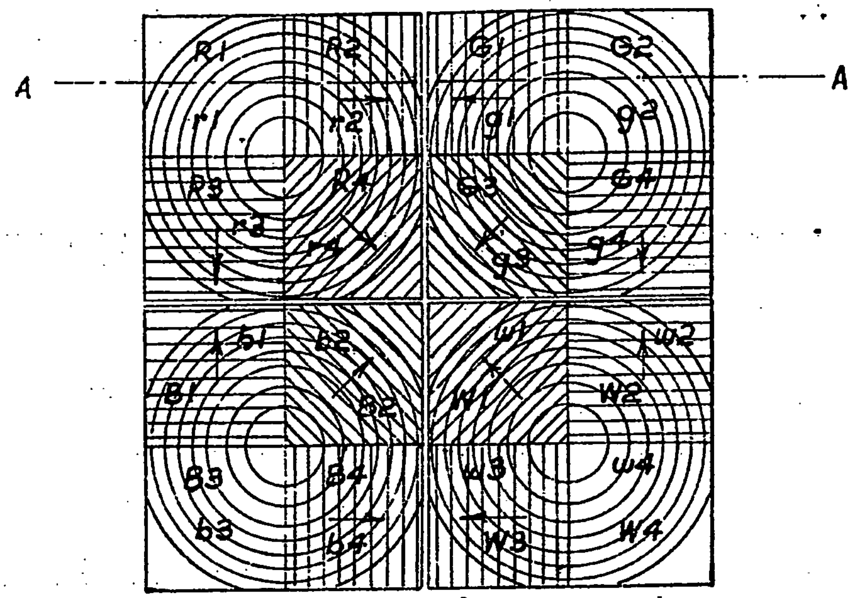

FIG. 2.

R1	G1	R2	G2
B1	W1	B2	W2
R3	G3	R4	G4
B3	W3	B4	W4

FIG. 3.

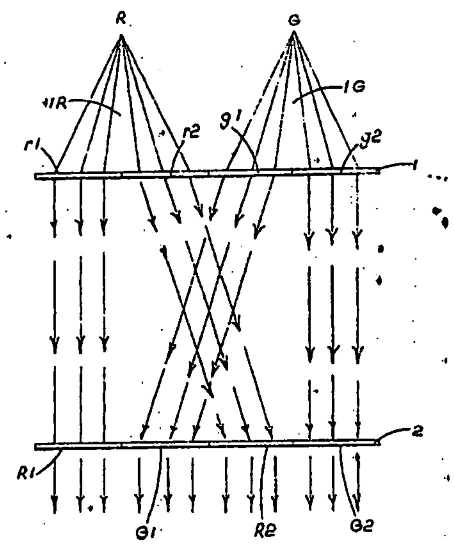

FIG. 1.

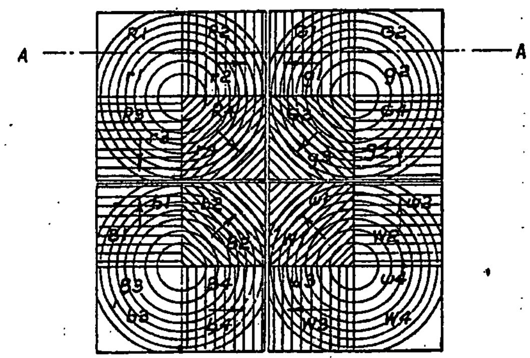

FIG. 2.

R1	G1	R2	G2
B1	W1	B2	W2
R3	G3	R4	G4
B3	W3	B4	W4

FIG. 3.

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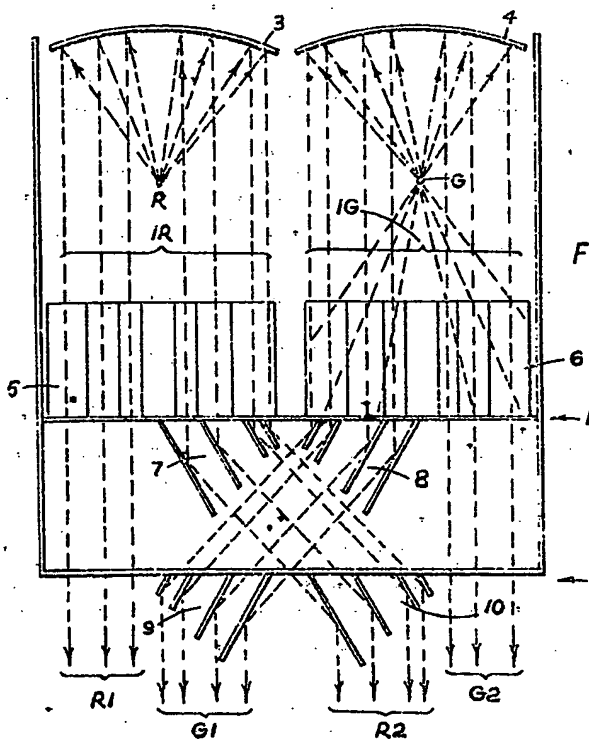

FIG. 4.

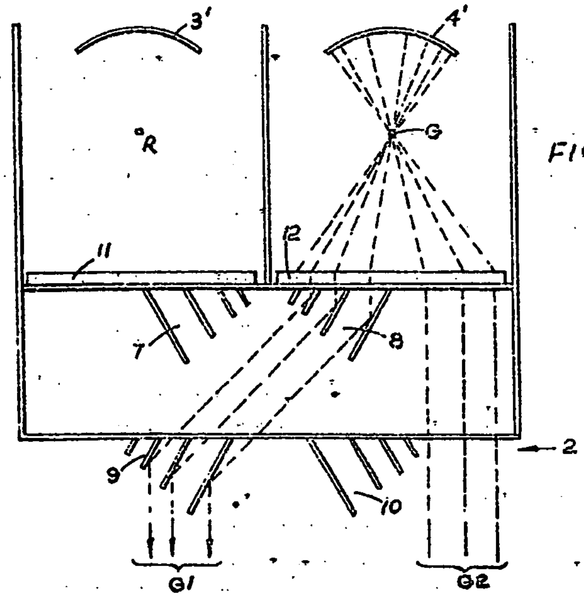

FIG. 5.

4 SHEETS

SHEET 3

SHEET 4

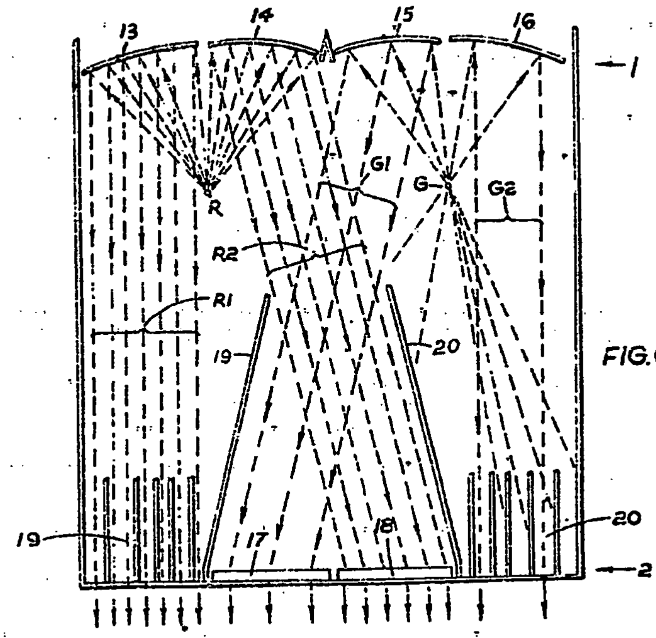

FIG. 6.

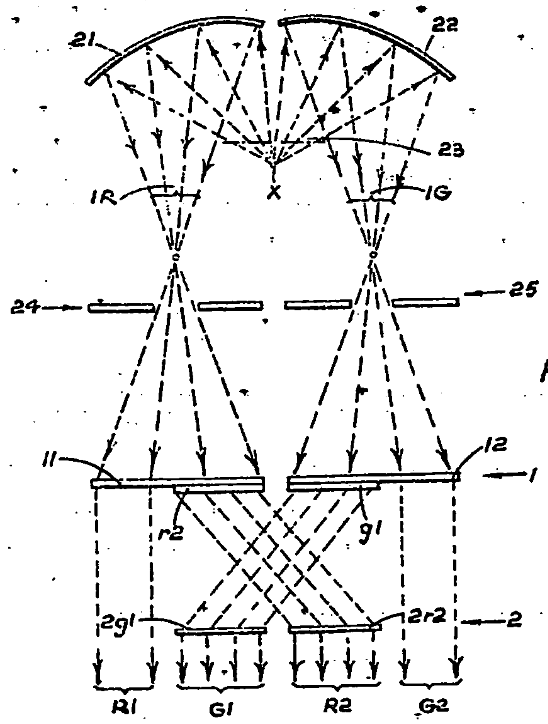

FIG. 7.

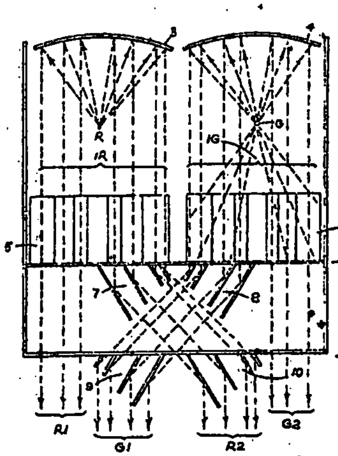

FIG. 4.

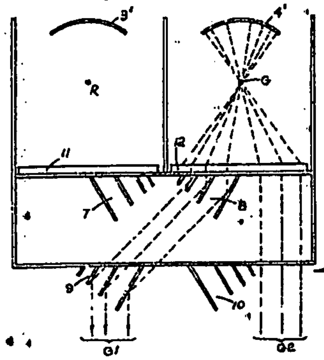

FIG. 5.

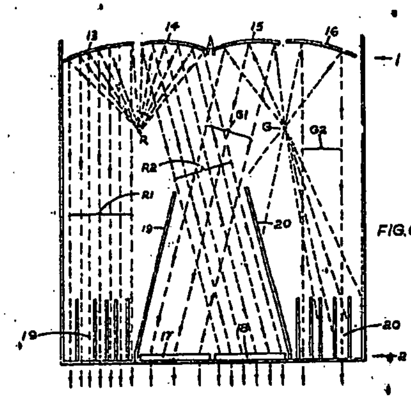

FIG. 6.

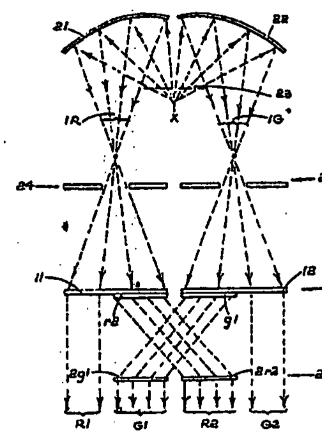

FIG. 7.

[This Drawing is a reproduction of the Original on a reduced scale]

H.M.S.O.(Ty.P.)